BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Application of San Diego Gas & Electric Company (U 902-E) for Approval of SB 350 Transportation Electrification Proposals.	Application 17-01-020 (Filed January 20, 2017)
And Related Matters.	Application 17-01-021 Application 17-01-022

PREPARED REBUTTAL TESTIMONY OF J.C. MARTIN

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
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I. OVERVIEW AND PURPOSE

My rebuttal testimony confirms that San Diego Gas & Electric Company's ("SDG&E's) modified Residential Charging Program[1] will produce positive grid impacts and greenhouse gas ("GHG") reductions associated with the original program design. I will also respond to certain contentions in the testimony submitted by intervening parties.

My rebuttal testimony is organized as follows:

- II. Grid Integrated Electric Vehicle ("EV") Charging Maximizes Benefits
- III. Level 2 ("L2") Charging is Necessary for Managed Charging
- IV. Managed Charging Should Be Encouraged for All Drivers, Not Just New EV Drivers
- V. SDG&E's Cost-Effectiveness Analysis Is Valid

II. GRID-INTEGRATED EV CHARGING MAXIMIZES BENEFITS

Senate Bill ("SB") 350 states that "[d]eploying electric vehicles should assist in grid management, integrating generation from eligible renewable energy resources, and reducing fuel costs for vehicle drivers who charge in a manner consistent with electrical grid conditions."[2] The grid-integrated EV charging (a.k.a. managed charging) enabled by SDG&E's modified Residential Charging Program is consistent with these goals for each of the following reasons:

- Managed charging can help reduce upward pressure on rates for all ratepayers: As I explained in my direct testimony, by improving SDG&E's load factor (which is a measure of system efficiency), managed charging helps lower wholesale electricity costs for SDG&E ratepayers;

[1] The specific modifications to the Residential Charging Program are described in the Rebuttal Testimony of Randy Schimka.
[2] Pub. Util. Code § 740.12(a)(1)(G)

defer new generation and distribution capacity infrastructure investments; and reduce average costs by spreading fixed costs over more sales.[3]

- Integrating generation from eligible renewable energy resources is enhanced with managed charging: Managed charging benefits ratepayers by lowering renewable integration costs. Specifically, managed charging can provide ramping support for renewable energy resources, as well as other integration benefits.[4] SDG&E is well ahead of other IOUs with respect to procuring renewable generation resources,[5] indicating a greater value in SDG&E's service territory for managed charging. SB 32's GHG goals will likely require expanding renewable integration capabilities, including managed charging, for decades to come.

- Managed charging helps EV drivers reduce fuel costs: Managed charging through the use of L2 Electric Vehicle Supply Equipment ("EVSE") and in conjunction with a grid-integrated rate ("GIR") and EV time-of-use (TOU) rates, which are key features of SDG&E's modified Residential Charging Program, offer participants the opportunity to charge during the lowest cost hours and meet their driving needs.

III. L2 CHARGING IS NECESSARY FOR MANAGED CHARGING

A number of intervenors object to the need for residential L2 EVSE, claiming that L1 EVSE charging (a.k.a. "trickle charging") is sufficient to achieve the objectives outlined above.[6] However, as described in the following sections, Level 1 ("L1") charging will not generate the same opportunities for managed charging associated with L2 charging, such as opportunities to improve SDG&E's load factor, integrate renewables, and reduce fuel costs.

A. L1 EVSE Do Not Provide the Same Benefits that L2 EVSE Offer

Both The Utility Reform Network ("TURN") and Office of Ratepayer Advocates ("ORA") recognize the benefit of load-shifting.[7] However, ORA and TURN do not believe L2

[3] SDG&E Direct Testimony (J. Martin) at JCM-21:10 to JCM-23:6.
[4] Vehicle - Grid Integration at 7-8 (2014), California Public Utilities Commission, *available at*: http://cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/EE_and_Energy_Savings_Assist/CPUCEnergyDivisionVehicleGridIntegrationZEVSummit.pdf (accessed 9/1/17).
[5] California Renewables Portfolio Standard (RPS): Current Renewable Procurement Status, *available at*: http://www.cpuc.ca.gov/RPS_Homepage/ (accessed 9/1/2017).
[6] ORA Testimony at page 1-6:25-26; and TURN Testimony (E. Borden) at 5:1-3.
[7] ORA Testimony at 1-6:24; and TURN Testimony (E. Borden) at 2:11-12.

EVSE is required for residential charging. I could not disagree more. The L1 EVSE is simply too slow to meet driving needs and at the same time provide load-shifting and managed charging benefits. L2 EVSE can be three to seven times faster than L1 EVSE.[8] Managed charging requires the flexibility to shape and shift charging to times when charging is more beneficial to the grid (e.g., delay charging to lower price hours and avoid higher price hours).[9] L1 EVSE requires long charging durations to meet driving needs, thus limiting its flexibility to shape and shift charging to times more beneficial to the grid.

ORA and TURN focus on the argument that L1 EVSE provides sufficient charging to meet average driving needs. ORA cites average daily travel of 40 miles a day and L1 average daily charging time of 7.1 hours.[10] TURN estimates most drivers travel around 30 or 40 miles a day,[11] and assumes L1 charging provides 4-5 miles of electric range per hour.[12] The ORA and TURN estimates result in L1 charging times between 6 to10 hours, or longer if daily driving needs extend beyond their averages. Moreover, because many EVs default L1 charging to 8-amps rather than the 12-amp standard, L1 charging times can be even longer.[13]

Recent rate design changes, including the adoption of new time-of-use ("TOU") periods,[14] make the faster L2 charging even more critical. This is because by being faster, L2 charging provides EV drivers a greater ability to get more charge during super off-peak hours

[8] Guide on Charging Your Electric Vehicle at Home, ChargeHub, *available at*: https://chargehub.com/en/home-charging-guide-electric-vehicles.html (accessed 9/1/2017).
[9] SDG&E Testimony (J. Martin) at JCM-21:4-7.
[10] ORA at 1-6:27-28.
[11] TURN Testimony (E. Borden) at 5:4.
[12] *Id*. at footnote 17.
[13] (8 amps / 12 amps = 66% or 33% longer) L1 8-amp default is standard for Chevy EVs (Volt, Spark & Bolt), the Chevy L1 charging level can be increased to 12-amps but expires after 90 days. See Discussion Board regarding Chevy Bolt, *available at*: http://www.mychevybolt.com/forum/viewtopic.php?f=12&t=5674&sid=0f92a54dd29b60791e81d2d87948c477&start=10 (accessed 9/1/2017).
[14] *See* Commission Decision ("D.") 17-08-030 at 24-26 and O.P. 8 (issued Aug. 25, 2017).

(Midnight-6:00 a.m.). TURN argues that default TOU rates will shift load to off-peak times.[15] This argument missed the point. The point is that L2 charging will provide a greater ability to get a full charge during the lowest cost super off-peak periods, whenever they might be. An L1 charger, on the other hand, creates the risk that the EV driver will not be able to get a full charge during the lowest cost super off-peak period, resulting in range anxiety or higher fuel costs.

SDG&E's modified Residential Charging Program also unlocks additional grid integration benefits associated with "smart, connected Level 2 chargers," (also known as networked EVSE).[16] Networked L2 EVSE provide the flexibility to participate in Demand Response programs where program events can limit available low cost charging hours.[17] Networked L2 EVSE that record interval consumption data enables drivers to more easily respond to "real time signals" and "EV-only TOU rates".[18]

B. Larger EV Batteries Increase the Need For Residential L2 EVSE

Larger EV battery sizes[19] make L2 charging even more important for managed charging, GHG reductions, and lower fuel costs. According to the California Air Resources Board ("CARB"), "[b]attery pack capacities have increased in both BEVs and PHEVs, and will likely continue to do so based on manufacturer announcements."[20] With larger EV battery capacities comes the capability to accommodate longer distance travel. This results in additional avoided

[15] TURN Testimony (E. Borden) at 19:1-2.
[16] ChargePoint Testimony (D. Packard) at 7:3-7.
[17] TURN acknowledges that Ratepayers can benefit when EVs shift load to off-peak times or participate in demand response program. See TURN Testimony (E. Borden) at 18:39-40.
[18] ChargePoint Testimony (D. Packard) at 7:7 and 7:22-23.
[19] The second-generation Chevrolet Volt has 50% more capacity than the first generation while the Toyota Prius Prime has 100% more capacity than the first generation. The Chevrolet Bolt is now the lowest cost vehicle with a 200+ miles range. *See* "6 Automakers Will Lead the Way to EV Battery Growth", DesignNews, *available at*: https://www.designnews.com/alternative-energy/6-automakers-will-lead-way-ev-battery-growth/150464139746918 (accessed 9/1/2017).
[20] California's Advanced Clean Cars Midterm Review at Appendix C, Section II.B.2, at C-9 to C-11, California Air Resources Board, *available at*: https://www.arb.ca.gov/msprog/acc/mtr/appendix_c.pdf (published Jan. 18, 2017)(accessed 8/25/2017).

petroleum fuel consumption and associated GHG reductions. Longer distance travel will require greater charging durations. In this situation, L1 charging could extend into on-peak periods (e.g., 4 p.m. to 9 p.m.), or could result in a greater likelihood that EV drivers may leave home without sufficient EV range to meet daily travel needs.

TURN cites an Applied Energy study that indicates home L1 charging is sufficient for 89% of normal daily travel needs on weekdays and 85% on weekends.[21] However, the same study also reveals L2 charging satisfies more daily travel needs than L1 charging.[22] The study also does not address the implications of L1 or L2 charging with larger battery capacities in current and future EVs.[23]

IV. MANAGED CHARGING SHOULD BE ENCOURAGED FOR ALL DRIVERS, NOT JUST NEW EV DRIVERS

TURN and ORA advocate for limiting program participation to only new EV drivers, claiming that existing EV drivers who participate in the program would be "free riders" because they already own an EV and don't require an additional incentive to purchase an EV.[24] This proposal is misguided because it would result in missing the opportunity to incentivize many existing EV drivers to switch to a new rate that is designed to produce managed charging benefits. Indeed, only 38% of current SDG&E EV drivers have chosen EV TOU rates.[25] This leaves about 14,000 existing EV drivers[26] who are charging under rates that are not designed to

[21] TURN Testimony (E. Borden) at 5, fn 15.
[22] Saxena, Samveg, et al. "Charging ahead on the transition to electric vehicles with standard 120 V wall outlets" at 724, Figure 4. Applied Energy. Lawrence Berkeley National Laboratory, University of California at Berkeley (Nov. 1, 2015), *available at*: http://www.sciencedirect.com/science/article/pii/S0306261915005899.
[23] *Id*. at 726, fn 2. The Applied Energy study uses a simulated vehicle resembling an 84 mile range Nissan Leaf.
[24] TURN Testimony (E. Borden) at 19:4-5, fn 49; *see also* ORA Testimony at 1-7:9-12.
[25] SDG&E Direct Testimony (R. Schimka Chapter 4) at RS-19:5-6.
[26] *Id*. at RS-6:14.

promote managed charging or rates that are not designed to maximize such benefits. Thus, rather than view existing EV drivers as free-riders, SDG&E prefers to see them as an untapped source of managed charging benefits. These first adopters helped pave the way for future EV drivers (i.e., future program participants), and through properly incentivized charging, they can continue to help reach California's SB 350 goals.

V. SDG&E'S COST-EFFECTIVENESS ANALYSIS IS VALID

Despite TURN's appreciation that SDG&E took the effort to conduct a standardized cost-effectiveness analysis,[27] as shown below, TURN makes several unfounded claims regarding the SDG&E Cost-Effectiveness analysis.

A. TURN Incorrectly Estimates the Load Shifting Benefit of the Residential Charging Program.

TURN incorrectly claims, "the avoided energy and capacity costs … due to shifting charging from on-peak to off-peak times amount to a small fraction of the total program cost."[28] TURN's incorrect statement appears to be based on an incorrect reading of a data request response. Specifically, TURN's $38 million value is representative of 30,678 EVs included in the Reference Case, not the 90,000 EVs associated with the program costs in TURN's Figure 2.[29] TURN should have corrected for the number of vehicles, which results in a $111 million load shifting benefit for SDG&E's Residential Charging program.[30] Although load shifting benefit may be less than the program costs, SB 350 clearly states "[p]rograms proposed by electric

[27] TURN Testimony (E. Borden) at 14:12-13.
[28] TURN Testimony (E. Borden) at 6:12-14 and 7:2-5 Figure 2.
[29] See Attachment A to this testimony, TURN-SDG&E-DR-01, Q10(C) response: "*These calculations hold EV adoption constant at the reference case level*, excluding the effect of program-driven increases in EV adoption. They do incorporate the assumption of Level 2 charging enabling increased electric vehicle miles traveled (eVMT).". (Emphasis added)
[30] $38M x (90,000 Program Case EVs / 30,678 Reference Case EVs) = $111.5M

corporations shall seek to minimize overall costs and maximize overall benefits".[31] Thus SB 350 is not a no-cost standard.

B. Managed L2 Charging has a Greater Distribution System Benefit Potential than L1 Charging

TURN suggests that "L2 charging has a greater impact on the distribution grid" relative to L1 charging based on an EPRI study and chart.[32] TURN omits the fact that the EPRI chart presented in TURN's Figure 1, clearly shows "240V Diversified Charging" has similar distribution impacts to L1 charging.[33] EPRI's "240V Diversified Charging," also called controlled charging in the study, is similar to the managed charging provided by SDG&E's modified Residential Charging Program. Also, TURN omits the fact that the EPRI source states "[c]ontrolled charging can significantly reduce loading impacts on the distribution system."[34] EPRI also believes "that the utility will not be able to manage this risk in an ex-post fashion" and "a proactive risk mitigation strategy is recommended to remove localized risk to the distribution system."[35] Networked L2 EVSE provide much more flexibility and opportunity to provide a proactive risk mitigation strategy than L1 EVSE. Managed charging via networked L2 EVSE in SDG&E's modified Residential Charging Program can help reduce load impacts on both the overall grid, as well as local distribution circuits.

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[31] Cal. Pub. Util. Code § 740.12(b)
[32] TURN Testimony (E. Borden) at 5:12-13.
[33] *Id*. at 6:3-4, Figure 1.
[34] Maitra, Dr. Arindam. "Preparing the Distribution Grid to Embrace Plug-in-Electric Vehicles" at 10, Electric Power Research Institute, *available at*: https://www.naefrontiers.org/File.aspx?id=35295 (accessed 9/1/2017).
[35] *Id*. at 10.

C. TURN's Other Claims that SDG&E Analysis Is Flawed Are Unfounded

TURN describes three potential flaws in SDG&E's Load Shifting Benefits analysis.[36] TURN's first concern is the assumption that the residential GIR perfectly incents customers to shift load.[37] This is an unfounded concern because the assumption also applies equally to the Reference Case TOU customers.[38] Furthermore, if a GIR customer charges at times that impact the circuit and/or grid, the customer will pay the CPP adder rates which compensate ratepayers for any adverse impacts.[39] TURN's second concern is that customers are moving to default TOU rates.[40] Default TOU is an assumption already included in the Reference Case which is used to calculate net impacts.[41] TURN's third concern is that SDG&E's analysis uses a resource balance year[42] adopted by the Commission for analyzing Distributed Energy Resource ("DER")[43] impacts.[44] SDG&E used the Avoided Cost calculator for its intended purpose – estimating the avoided costs of a DER consistent with resource balance year direction in D.16-06-007.[45]

This concludes my rebuttal testimony.

[36] TURN Testimony (E. Borden) at 6, fn 21.
[37] *Id*. at 6, fn 21.
[38] SDG&E Testimony (J. Martin) Appendix A, Section 2.1.2, at 4.
[39] SDG&E Testimony (C. Fang) at CF-25:5 to CF-26:2 (Dynamic Adders for System and Circuit top hours).
[40] TURN Testimony (E. Borden) at 6, fn 21.
[41] SDG&E Testimony (J. Martin) Appendix A, Section 4.2, Table 11, at 19. SDG&E includes an assumption of TOU opt-out to the tiered DR rate.
[42] The resource balance year is the year that the Avoided Cost Model assumes new capacity is needed to maintain planning reserve margins to reliably meet load.
[43] Distributed energy resources ("DER") are defined as distribution-connected distributed generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies.
[44] TURN Testimony (E. Borden) at 6, fn 21.
[45] D.16-06-007 (6/15/2016) at 17, and OP 7.

VI. STATEMENT OF QUALIFICATIONS

My name is John C. Martin. My business address is 8306 Century Park Court, San Diego, California 92123. I am employed by SDG&E as Team Lead in Clean Transportation. I have over 24 years of energy industry experience. My current duties involve project and team management to support SDG&E's electric transportation efforts, including EV rates, program support, and implementing a pilot using third-party EV submeters.

Prior duties focus on benefits associated with the capabilities of Smart Metering and Home Area Networks, conservation based information feedback, and Vehicle-Grid Integration benefits. My prior electricity work experience includes development of demand response programs and tariffs, trading and scheduling electricity, evaluating demand side management program, and load research of customer energy use. This work draws upon my broad experience in the electricity and oil industry, including the oil trading, refining and marketing industries.

My EV driving experience began in 1997. I currently own and previously leased a plug-in hybrid EV since January 2013. I actively charge my vehicle at home, at my workplace, and at public facilities.

My education is in the general area of resource economics. I graduated from Cornell University in 1988 with a master's degree in agricultural economics. My bachelor of science degree was granted by Purdue University in 1984 in business and farm management. I have previously testified before the Commission.

ATTACHMENT A

(Data Request Response Cited in Rebuttal)

TURN DATA REQUEST
TURN-SDG&E-DR-01
SDG&E SB 350 TRANSPORTATION ELECTRIFICATION PROPOSALS (A.17-01-020)
SDG&E RESPONSE
DATE RECEIVED: February 9, 2017
DATE RESPONDED: February 24, 2017

Question 10

a. Please calculate the benefit to the system, in dollar terms on an annual basis, from program participants shifting load from on-peak to off-peak. Please provide all workpapers and assumptions.

SDG&E Response (prepared by JC Martin):

SDG&E cannot perfectly isolate the system (Electricity Supply Cost) impact of shifting load from on-peak to off-peak in the cost-effectiveness results, including system marginal costs. To be responsive to this question, E3 performed calculations to isolate the combined impact on system marginal costs (i.e., incremental grid costs) of a) increasing charging from Level 1 to Level 2, and b) switching the tariffs applicable to EV charging from the DR and EV-TOU-2 schedules to the Residential GIR schedule. *These calculations hold EV adoption constant at the reference case level, excluding the effect of program-driven increases in EV adoption.* They do incorporate the assumption of Level 2 charging enabling increased electric vehicle miles traveled (eVMT). These calculations can be found in the workbook attached below "Res Results Scenario A with TURN DR1 Q10dc Analysis.xlsx," worksheet "TURN DR1 Q10cd", Rows 42 through 48.

This workbook shows the net marginal electricity supply cost benefit of Level 2 charging with the GIR rate, relative to Level 1 charging with the DR and EV-TOU-2 rate. In 2020, the marginal electricity supply benefit is $209 per vehicle (or customer).

[*emphasis added*]